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## Abstract

**Background:** Fetal Alcohol Spectrum Disorders is a term used to describe a range of physical, cognitive and behavioural deficits in the offspring of women who drank alcohol during pregnancy. A growing body of evidence suggests alcohol consumption in the presence of poor maternal nutrition may increase the risk of harm to the developing fetus.

**Objective:** To investigate relationships between maternal dietary patterns and alcohol consumption, and explore which factors influence women's decisions about what to eat and drink during pregnancy.

**Design:** A mixed methods study comprising of a questionnaire (paper-based and online) and semi-structured, in-depth interviews with a sub-sample of women who completed the questionnaire.

**Participants:** Women were eligible for inclusion if they were  $\geq 16$  years of age, pregnant and living in the UK and were recruited through antenatal clinics, specialist substance misuse antenatal clinics and via social media platforms; 350 women completed a questionnaire and a sub-sample of 6 women participated in an interview.

**Methods:** The questionnaire comprised the Alcohol Use Disorders Identification Test Consumption to measure alcohol consumption patterns and a Food Frequency Questionnaire to measure dietary intake. Dietary pattern analysis was conducted using Principle Components Analysis and linear regression models were used to explore relationships between dietary pattern scores and alcohol consumption. Analyses were adjusted for socio-demographic and lifestyle characteristics. Semi-structured, in-depth interviews were conducted face-to-face and data were analysed thematically.

**Findings:** Two key dietary patterns were derived. Women who reported frequent alcohol consumption before and during pregnancy were more likely to adhere to the 'Prudent' dietary pattern compared to those who abstained. No relationships were observed between alcohol consumption and adherence to the 'Cafeteria' dietary pattern. Six key themes were identified through the qualitative analysis: 1) pregnancy as a time to review behaviour; 2) listen to your body – it will tell you what you need; 3) treats are still important – on special occasions; 4) social and cultural expectations constrain behaviour; 5) inconsistent or ambiguous information creates uncertainty; and 6) confidence increases following a successful pregnancy.

**Conclusions:** Those who drink low levels of alcohol during pregnancy may have better quality diets compared to women who report no alcohol consumption. The reasons for this are complex and influenced by social

Exploration of dietary patterns and alcohol consumption in pregnant women in the UK: A mixed methods study

context and previous pregnancy experience, which should be considered when healthcare professionals provide advice during this period.

### **Keywords**

Alcohol; Antenatal; Diet; Health behaviours; Qualitative; Survey

### **Abbreviations**

**FASD** Fetal Alcohol Spectrum Disorders

**ALSPAC** Avon Longitudinal Study of Parents and Children

**CI** Confidence Interval

**FFQ** Food Frequency Questionnaire

**AUDIT-C** Alcohol Use Disorders Identification Test Consumption

**PCA** Principle Components Analysis

**NRES** National Research Ethics Service

**NHS** National Health Service

**UK** United Kingdom

**HEI** Healthy Eating Index

**SES** Socio-economic Status

## Introduction

Fetal Alcohol Spectrum Disorders (FASD) is a term used to describe a range of physical, cognitive and behavioural deficits in the offspring of women who drank alcohol during pregnancy (1). The prevalence of FASD is estimated to be between 1.06 and 113.22 per 1,000 live births globally (2). In Canada, active case ascertainment estimated prevalence is 30.52 per 1,000 live births and estimated to cost \$169 million per year (3,4).

It is widely accepted that FASD is caused by the teratogenic effects of ethanol on fetal development leading to brain damage and physical abnormalities (5). A growing body of evidence suggests alcohol consumption in the presence of poor maternal nutrition may increase the risk of harm to the developing fetus. Animal models of FASD have indicated that particular micronutrients may mediate the relationship between ethanol and harm (6–9). When pregnant rats were exposed to ethanol a protective effect from folate, choline, vitamin E and carotenoids was shown. Their offspring had higher birth and brain weights (10), less damage to their brain structure (11–13), and showed fewer signs of cognitive and behavioural deficits associated with antenatal ethanol exposure (10,14).

Similar findings have been reported in human populations. A significant reduction in maternal to fetal transport of folate was observed in pregnancies exposed to high levels of alcohol (15), and multivitamin supplements may ameliorate some of the harm from antenatal alcohol exposure (16). These findings are particularly important as it has also been shown that, in the general population, health-risk behaviours, such as alcohol consumption and a poor diet, tend to co-occur and significantly increase the risk of chronic ill health (17,18).

Nutrient intakes provide valuable insight into the diet quality of populations. However, there are limitations to single nutrient analysis, which has been discussed in a number of review papers (19,20). The effect of a single nutrient may be too small to detect on its own, and nutrients are not consumed in isolation; therefore, the measurement of a single nutrient may actually be a proxy for the effect of a group of nutrients being consumed together. Dietary patterns provide a better reflection of 'true' dietary intake by focusing on how food and drinks are consumed together, which may be a more powerful indicator of diet quality (19).

While there are a number of studies exploring relationships between various aspects of alcohol consumption and dietary patterns in the general population (21–27), little research has been published on pregnant women, but an unpublished analysis of data from the Avon Longitudinal Study of Parents and Children (ALSPAC) found that women who reported binge drinking during pregnancy were more likely to adhere to a diet characterised by high intakes of meat and processed foods, and low intakes of fresh fruit and vegetables (28). Data were collected during pregnancy as part of ALSPAC more than 20 years ago and further research is needed with contemporary populations of pregnant women.

The implications of these findings are that interventions to reduce the risk of FASD may be more effective if they tackle co-occurring health-risk behaviours, particularly alcohol consumption and poor nutrition. This requires a better understanding of the association between maternal alcohol consumption and dietary intake; and what influences women's choice of what they eat and how much alcohol they drink during pregnancy. Understanding these relationships and how these choices are made may facilitate identification of at risk populations of women and highlight targets for interventions to improve health behaviours. Therefore, the key objectives of this study included: deriving maternal dietary patterns and exploring in relation to patterns of maternal alcohol consumption, before and during pregnancy; and conduct interviews with women to gain insight into what factors influence women's choices about what they eat and drink during pregnancy.

## Methods

A two-phase, explanatory design was implemented whereby quantitative and qualitative data were collected sequentially. Phase one comprised a cross-sectional survey, which included a purposely designed food frequency questionnaire (FFQ) that provided detailed data on levels of alcohol and micronutrient consumption and patterns of maternal diet. Phase two comprised semi-structured, in-depth interviews to explore the attitudes, beliefs and concerns that produced these patterns.

### Sample population

Initially, women were eligible for inclusion if they were pregnant, aged 16 or older, attending their 12-week antenatal scan at antenatal clinics in Gloucestershire, and reported any alcohol consumption during their current pregnancy. Non-English speakers and women suffering severe morning sickness were excluded (recruitment routes i and ii). Due to slow recruitment, eligibility criteria were widened to include pregnant women, aged 16 or older, living anywhere in the UK, at any gestation, and were drinking or not drinking and alcohol consumption during their current pregnancy (recruitment route iii).

### *Phase one: Cross sectional survey*

Recruitment was via three routes: (i) Women attending their 12-week scan at five antenatal clinics across Gloucestershire were given a short screening questionnaire to complete by the clinic receptionist. The screening questionnaire contained the Alcohol Use Disorders Test-Consumption (AUDIT-C) (32). Women were invited to complete this while they waited for their appointment and then place it in a sealed envelope and then into a sealed collecting box. Women were invited at this time point as the vast majority of pregnant women in the UK will attend an appointment to have an ultrasound scan and blood samples taken, and it is very likely that women will have periods of waiting in the clinic reception area in between appointments. Women who reported any alcohol consumption were sent a copy of the second questionnaire which included the FFQ and the AUDIT-C. The screening questionnaire was only used to identify women who were drinking

and the alcohol data collected as part of this stage was not included in the analysis. When women were sent the full questionnaire, which included the FFQ, they were asked the same alcohol questions again. These were included in the analysis. Therefore, the time point at which women answered these questions will have varied.

(ii) Women attending either of two specialist substance misuse antenatal clinics were informed about the study by their clinician. Women who were interested in participating provided their contact details and were contacted at a later date by the first author (VC). Women who wished to participate were sent a copy of the FFQ.

(iii) Due to slow recruitment, an online version of the questionnaire was created and advertised on social media platforms (Twitter and Facebook). The eligibility criteria were widened at this stage to include women who met the criteria stated above. Submission of a completed questionnaire implied consent.

**[Figure 1 here]**

#### Data collection and measures

Women completed one questionnaire which included questions on alcohol consumption, dietary intake and socio-demographic characteristics

##### *Alcohol consumption*

The questionnaire included the Alcohol Use Disorders Test-Consumption (AUDIT-C) (32), which asks questions on the frequency of alcohol consumption per week, the quantity of alcohol consumed per drinking occasion and frequency of binge drinking (defined as six or more units in one occasion). Women were asked about their alcohol consumption in relation to two time periods: the 12 months *before* their current pregnancy and the time *since* they became pregnant. The AUDIT-C was self-completed at both time points.

##### *Dietary intake*

Dietary intake was measured using the FFQ (29) which was modified from an existing questionnaire (30) and comprised 113 food and drink items grouped into 32 categories. The reported frequency of certain food and drink items differed i.e. tea and coffee was reported as number of cups per day, but other items were reported as portions per week. All frequencies were converted to weekly intakes before analysis.

##### *Socio-demographic characteristics*

Participants were asked their age ('<25'/'25-29'/'30-34'/'35+'), parity ('Primiparous'/'Multiparous'), educational attainment ('<bachelor's degree'/'≥bachelor's degree'), occupation ('Unemployed'/'Non-

managerial professional'/'Managerial professional'), ethnicity ('White'/'Not white'), marital status ('Married'/'Not married') and smoking status ('Smoker'/'Non-smoker').

### *Statistical analysis*

Continuous variables were summarised as means and standard deviations or medians and ranges, and categorical variables were summarised as frequencies and percentages. Continuous variables were tested for normality using histograms and the Shapiro-Wilk test. Non-normally distributed variables were log-transformed before analysis.

Dietary pattern scores were derived using Principle Components Analysis (PCA). PCA with varimax rotation was performed on the standardised food and drink items (31,32). Eigenvalues were produced in a scree plot, to provide a visual assessment of which component factors explain the most variability in the data. The scree plot indicated that two components (dietary patterns) should be investigated further. Food and drink items with a factor loading of  $\leq -0.3$  or  $\geq 0.3$ , respectively suggesting a strong negative or positive association (33) were considered to be significant descriptive characteristics of that dietary pattern. A dietary pattern label was given to each component investigated based on these characteristics. A total dietary pattern score for each participant was calculated by multiplying the factor loadings by the corresponding z-score and summing all values. A summary score is created for each participant and dietary pattern. The mean score is zero, with a score above or below indicating respectively a higher or lower adherence to that dietary pattern (19).

Logistic regression models were used to explore whether women who were recruited via social media differed by socio-demographic characteristics, reported alcohol consumption and dietary pattern scores, compared to those recruited via antenatal clinics. Unadjusted linear regression models were used to explore associations between dietary pattern scores and alcohol consumption, before and during pregnancy. Dietary pattern scores were treated as continuous, dependent variables, and alcohol consumption as categorical, independent variables. Separate models were run for the two emergent dietary patterns. All other covariates were then added to the regression models. Unadjusted and adjusted regression models are presented with 95% confidence intervals (CI) and p-values. All data were analysed using Stata 13.1.

### *Missing data*

Women who completed paper-based questionnaires were excluded from the present analysis if 10 or more food and drink items were missing (blank response) from the FFQ. In cases where fewer than 10 were missing, these items were coded as zero to indicate they were not regularly consumed (33). In order to submit the questionnaire online, women had to complete every question on the FFQ section of the questionnaire; trying to proceed would produce a message on screen prompting women to provide missing data. Women who started but did not submit an online questionnaire were excluded from the analysis, as consent could not be inferred.

### ***Phase two: Interviews***

A sub-sample of women was recruited from phase one to participate in phase two. Whatever the route of recruitment, the final page of the questionnaire included an invitation to take part in an interview. Those women who agreed to do so took part in an in-depth, semi-structured face-to-face interview. A topic guide was developed based on findings from existing literature and phase one. The first author (VC) conducted all interviews, which were audio recorded and transcribed for analysis.

### ***Qualitative analysis***

Interviews were professionally transcribed and checked by the interviewer then uploaded onto Nvivo 10 (34) software for coding and management. Interviews were analysed thematically following the guidelines developed by Braun & Clarke (35) which was chosen as a widely-used, flexible and pragmatic approach.

## **Results**

### ***Phase one: Cross sectional survey***

A total of 350 women completed the questionnaire and their socio-demographic characteristics are presented in **Table 1**. The majority of women who completed the questionnaire were over 30 years old, white, educated to degree level, non-smokers and in professional occupations. There were no significant differences in age, ethnicity, education, smoking status and occupation between women who were recruited online (n=314) and those recruited in antenatal clinics (n=36), therefore they were combined for subsequent analyses.

***[Table 1 about here]***

Approximately 95% of women reported consuming some alcohol and 41% reported drinking 2-3 times per week during the 12 months prior to pregnancy recognition (**Table 2**). The majority (75%) of women reported binge drinking in the 12 months before pregnancy recognition, 32% doing at least monthly. During pregnancy, alcohol consumption patterns markedly changed, with 67% of women reporting they did not drink any alcohol during their pregnancy. Of those who reported alcohol consumption during pregnancy, all women reported drinking no more than 1-2 units per drinking occasion, no more than once per week, and only two women reported binge drinking less than once per month.

***[Table 2 about here]***

Two dietary patterns were derived. The 'Prudent' dietary pattern, was characterised by high intakes of fruit, vegetables, fish, salad and pulses and accounted for approximately 8% of variation in the data. The 'Cafeteria' dietary pattern was characterised by high intakes of fried food, chocolate, sweets, pudding and cakes and

accounted for approximately 5% of the variation. The factor loadings for both dietary patterns are presented in **Table 3**. Greater adherence to the 'Prudent' dietary pattern was associated with high educational attainment ( $\beta=0.15$ ,  $p=0.039$ ), and adherence to the 'Cafeteria' dietary pattern was associated with higher parity ( $\beta=0.29$ ,  $p=0.001$ ) and non-white ethnic origin ( $\beta=0.48$ ,  $p=0.012$ ).

*[Table 3 about here]*

Women who reported drinking alcohol 2-3 times per week before pregnancy were significantly more likely to adhere to the 'Prudent' dietary pattern compared with women who reported drinking alcohol on a less than monthly basis prior to pregnancy ( $\beta=0.46$ , 95% CI=0.20, 0.71;  $p<0.0001$ ) (**Table 4**). The effect size reduced but remained significant after adjusting for maternal age, parity, ethnicity, education, occupation, marital status and smoking ( $\beta=0.38$ , 95% CI=0.11, 0.65;  $p=0.006$ ). No relationships were observed between either dietary patterns or the quantity of alcohol consumed per occasion, nor between the 'Cafeteria' dietary pattern and frequency or quantity of alcohol consumption before pregnancy (See supplementary data for tables).

*[Table 4 about here]*

Women who reported drinking alcohol 2-4 times per month during pregnancy had significantly higher adherence to the 'Prudent' dietary pattern compared to women who reported *no* alcohol consumption during pregnancy ( $\beta=0.44$ , 95% CI=0.17, 0.7;  $p<0.0001$ ) (**Table 5**). This relationship persisted after adjustment for maternal age, parity, ethnicity, education, occupation, marital status and smoking ( $\beta=0.36$ , 95% CI=0.09, 0.63;  $p=0.009$ ). No relationships were observed between the 'Cafeteria' dietary pattern and frequency or quantity of alcohol consumption during pregnancy.

*[Table 5 about here]*

### **Phase two: Interviews**

Six women participated in qualitative interviews. Of these, four were recruited through antenatal clinics, one through a substance misuse antenatal clinic and one via the online questionnaire. The majority were married, employed and educated to degree level. All women were of white, European descent (**Table 1**).

Six key themes were identified through the qualitative analysis of the women's accounts of their approach to diet and alcohol in pregnancy: 1) pregnancy as a time to review behaviour; 2) listen to your body – it will tell you what you need; 3) treats are still important – on special occasions; 4) social and cultural expectations constrain behaviour; 5) inconsistent or ambiguous information creates uncertainty; and 6) confidence increases following a successful pregnancy



### *1) Pregnancy as a time to review behaviour*

All the women discussed how, as soon as they knew they were pregnant, they had reflected on their diet and alcohol consumption, though the type and scale of changes they made varied considerably. Most of the women described an interest in diet and nutrition prior to pregnancy which meant they did not feel they had had to make major changes to their overall diet. At the same time, however, all reported a change in their alcohol consumption: four women described a reduction in the amount they drank and two abstained entirely once they discovered they were pregnant. While all recognised that heavy alcohol consumption was potentially harmful, the women who reduced their alcohol consumption perceived no harm from low consumption and reported using “common sense” when deciding whether or not to have a drink.

“Yeah, so it’s definitely changed since I’ve become pregnant. The first three months I didn’t have any alcohol at all. Didn’t fancy it and obviously it’s just not good for the baby. And then the last four months I’ve let myself have, say, two glasses of wine a week. . . But I don’t know, personally I don’t think it would do any harm in the last few months, to have a few glasses of wine.” (Participant 2, 26-30 years, first pregnancy)

In contrast, women who cut out alcohol completely felt it was “better to be safe than sorry”. Interestingly, these women were the only women who perceived their alcohol consumption prior to pregnancy to be high.

“Just before I found out, I was drinking quite a lot...Well I don’t drink at all now. I don’t think there’d be anything wrong with having a glass of wine every now and then, but then I think, what’s the point?” (Participant 3, ≥36 years, one child, second pregnancy)

“It was a lot of drugs and alcohol involved. Like a very high extent, weekly and weekends. And since I found out I’ve been pregnant I’ve pretty much stopped everything now.” (Participant 6, 31-35 years, no children, second pregnancy)

All women reported eliminating certain foods from their diet during pregnancy to reduce the risk of harm to their unborn child: unpasteurised cheese, raw eggs, uncooked meats and seafood were the most consistently mentioned. Some women described reducing sugary foods and drinks, starchy carbohydrates and caffeine that were not recognised as directly harmful to the baby, but were perceived as better for their own or their baby’s health and wellbeing.

### *2) Listen to your body – it will tell you what you need*

Five women described cravings for particular foods during their pregnancy, which they interpreted as their body telling them what they needed to eat to compensate for nutrients they were missing. They felt confident that, because their body was telling them to do so, it was appropriate to satisfy their craving, which was commonly for starchy or sugary foods, fresh juicy foods and milk.

“Every now and then I get a real craving, like I feel like I’ve got to stop straight away and buy chocolate, so I have to pull into a garage or something, and I’ve never done that before. So that’s obviously the sugar rush or something isn’t it? You’re lacking something.” (Participant 1, 31-35 years, first pregnancy)

Similarly, some women described avoiding specific foods or alcohol during pregnancy because their body told them to do so.

“I think the first months I definitely didn’t want anything and I think maybe that might be my body’s way of actually telling me it’s not a good idea to have any alcohol now.” (Participant 2, 26-30 years, first pregnancy)

### *3) Treats are still important – on special occasions*

Some women referred to certain food and drink choices as a source of enjoyment and saw ‘treating’ themselves occasionally as a way of breaking their routine and giving themselves a lift.

“Maybe for somebody else it would be chocolate or a dirty burger or something, but for me it’s a glass of wine. I think it probably is the whole ‘treat’ you know, I think that’s what it is. I don’t really want it or need it I think, it’s just part of a habit and probably a naughty treat as well.” (Participant 1, 31-35 years, first pregnancy)

Several women described alcohol as a ‘treat’ and felt it was acceptable to have a glass of wine now and again, as a reward or as part of a celebration.

“I don’t drink now. Well I had one glass of wine on our wedding day [last month]. . . I thought ‘I’m allowed one on that day.’ And I had one on Christmas Day, but that’s it.” (Participant 5, ≤25 years, one child, second pregnancy)

By seeing them as ‘treats’, these women could enjoy a drink at these social events without it challenging their usually healthy lifestyle.

### *4) Social and cultural expectations constrain behaviour*

While they may have enjoyed the occasional 'treat', most women were sensitive to the views of family and friends regarding what was 'appropriate' for a woman to eat or drink during pregnancy. Several described concerns that their 'reputation' as a good mother was at risk if they did not conform to the, often conservative, expectations of others.

"Yeah, definitely benchmarked [what I do] against my mum and the rest of my family. If they were against it I don't, I don't see how I could have drunk alcohol because it just would have felt wrong. If the grandmother of my child was really against that, I think I would have been really self-conscious."  
(Participant 4, 26-30 years, first pregnancy)

For the same reasons, women who continued to drink alcohol during pregnancy were particularly interested in what other women in their social network thought was appropriate and were often reassured by their responses.

"I've had a chat with friends who've had babies and asked 'What did you do? Did you have any alcohol at all while you were pregnant?' . . . [And] generally they would just say they had a few glasses here and there and they didn't think it did any harm. Their babies were all fine." (Participant 2, 26-30 years, first pregnancy)

An interesting variant is illustrated by one woman who was concerned that her partner might tempt her into excessive drug and alcohol consumption: she left him and stopped seeing friends in their social network in order to resist engaging in her previous damaging health behaviours.

##### *5) Inconsistent or ambiguous information creates uncertainty*

A common theme in all interviews concerned inconsistencies in the advice given to women during pregnancy from a variety of sources, including friends, relatives, the internet and healthcare professionals.

"Midwives will say 'It's fine, have a couple of glasses a week, it's not going to do any harm.' And then you get opinions from everyone else on whether you should or shouldn't." (Participant 2, 26-30 years, first pregnancy)

Several women highlighted how guidelines from healthcare professionals on alcohol and certain foods have changed over the past few years. For a number of women this undermined their confidence in the advice and resulted in them seeking guidance from other sources, including family and friends.

"Also my mum, because I felt comparing 30 or 40 years of difference in guidance was a good way to contrast. So have they always said it? Or is it another new fad, new thing that people are saying but

actually in five years' time they will change again. So I really valued her opinion as well on some of the topics." (Participant 4, 26-30 years, first pregnancy)

#### *6) Confidence increases following a successful pregnancy*

Women who already had a child described their current attitude towards diet and alcohol as different from their first pregnancy. They felt more relaxed about their approach to food and drink, and referred to using their 'common sense' in interpreting guidance. They recalled feelings of anxiety during their first pregnancy but having a healthy baby gave them confidence in their ability to make their own choices 'second time around' and still have another healthy pregnancy.

"I think I have a pretty balanced diet this time round...I think I worried with my first too much, I think I could have enjoyed it a bit more, and had more food that I enjoyed, instead of worrying." (Participant 5, ≤25 years, one child, second pregnancy)

In contrast, negative experiences in previous pregnancies were associated with less confidence, more anxiety and stricter behaviour regarding food and drink. One woman had experienced a traumatic miscarriage at 5 months' gestation and felt very protective and fearful of harm for her baby.

"Yeah, I've become extremely protective really. I'm constantly looking things up online, am I doing things right, am I being good? Driving the midwife crazy with a million and one questions. Maybe a little bit too much, but it's all like healthy, it's all, because I just want the best." (Participant 6, 31-35 years, no children, second pregnancy)

## **Discussion**

To our knowledge, this is one of the first studies to explore relationships between maternal dietary patterns and alcohol consumption during pregnancy, and factors that influence what women choose to eat or drink during this period.

As part of this study, two key dietary patterns – 'Prudent' and 'Cafeteria' – were derived. Similar patterns of dietary intake have previously been described (41, 42), including a large cohort of 12,572 women of reproductive age in England which derived a 'Prudent' dietary pattern, characterised by high fruit and vegetable intakes, and a 'High energy' dietary pattern, characterised by high intakes of cakes, puddings and processed foods (42).

The positive relationship found in our study between *frequency* of alcohol consumption and adherence to the 'Prudent' dietary pattern is also supported by previous research. In a US study of healthy, non-pregnant adults, Breslow et al (2006) explored alcohol consumption in relation to the Healthy Eating Index (HEI) score, calculated on the intake of fruit, vegetables, red meat and dairy, with a higher score typically indicating a better quality diet. As in this study, Breslow et al (2006) found that as HEI scores increased, so did the *frequency* of alcohol consumption. However, the US study also found that HEI score decreased as the *quantity* of alcohol consumed *per occasion* increased, with those consuming highest quantities of alcohol over the fewest occasions having the poorest quality diets (37).

We found no relationship between quantities of alcohol consumed per occasion or binge drinking before pregnancy, and maternal dietary patterns. This was unexpected, based on the current published evidence from investigations in non-pregnant populations, which indicate that high quantities of alcohol per drinking occasion is associated with diets characterised by high intakes of red meat and processed foods (38–40), similar to the 'Cafeteria' dietary pattern derived in this study. The dietary patterns derived in this study accounted for a total of 13% of the data, which suggests other dietary patterns may exist, which may be associated with alcohol consumption.

The 'Cafeteria' dietary pattern was associated with being of non-white ethnic origin – a consistent predictor of abstaining from alcohol prior to and during pregnancy (42,43) – which may also have contributed to the lack of relationships observed between dietary and alcohol consumption patterns.

Prior to pregnancy, many women reported consuming alcohol in potentially risky patterns (5+ units per drinking occasion and binge drinking). Marked changes in alcohol consumption were reported during pregnancy, with women either completely abstaining or drinking only 1-2 units, no more than once per week. Findings from the interviews suggested a number of factors that influenced decisions about alcohol consumption. While all women accepted that there was a risk of harm from heavy consumption, those who continued to drink low amounts believed there was little risk in doing so. This finding is in line with current evidence, including two studies conducted in Australia, which reported that women who continued to drink low levels of alcohol during pregnancy perceived there to be very little or no harm from this (46,47).

In addition, women indicated that receiving inconsistent advice undermined their confidence in the current guidelines, which meant that they often followed advice from friends or family, rather than from healthcare professionals. Inconsistent advice has been reported as a barrier to alcohol abstinence in other studies. An Australian study reported women's concerns for clear, consistent guidance regarding alcohol consumption (47) while a qualitative study conducted in the UK reported contradictory guidance from healthcare professionals as a common reason for women turning to friends and family for advice (48). Ambiguous recommendations in national guidance documents make it difficult for midwives to provide consistent advice (Winstone 2015). During the time period that this study was conducted The Department of Health recommended that pregnant

women should avoid alcohol (NHS Choices, 2017 or DoH reference). However, whilst the National Institute for Health and Care Excellence (NICE) also recommends that women should be advised to avoid alcohol in the first 3 months of pregnancy, it also states that if a woman does choose to drink alcohol that they should be advised to drink no more than 1-2 UK units once or twice a week (NICE 2008 antenatal care guideline).

The importance of social and cultural expectations in women's decisions regarding food and alcohol during pregnancy was also identified. Those that continued to drink alcohol described similar patterns during pregnancy in their family and friends, but also indicated that they refrained from drinking alcohol when they perceived this would not be acceptable to others present. The role of social and cultural context on health behaviours is well supported by evidence (49–51) and the influence of friends and family on decisions around diet and alcohol in pregnancy has been highlighted in several other qualitative studies (48,52,53).

Previous experience of a successful pregnancy was also important in giving women more confidence in using their 'common sense' in making decisions about what to eat and drink. The relationship between parity and perceived risk during pregnancy has been reported in other studies. Two qualitative studies conducted in the US and UK found that women who had previously given birth were more likely to drink alcohol during pregnancy (48,54).

### *Strengths and limitations*

A key strength of this study is the contemporaneous collection of data on alcohol consumption and dietary patterns using valid instruments during the same reference period. The mixed methods design enabled us to explore women's accounts of their approaches to food and alcohol during pregnancy, providing a context for interpreting the results of the questionnaire.

The main limitation of this study is the small and homogenous sample population, of which the majority of women were white, well educated, non-smokers. This reflects widely acknowledged challenges of recruiting women from ethnic minority and low-income backgrounds, increasing the risk of bias by threatening the external validity of the study. Recruiting women of higher socio-economic status (SES) is a common phenomenon in public health research (58) and a study exploring barriers to minority and lower SES populations taking part in research reported a lack of time, childcare and awareness as reasons for non-participation (59). Another limitation is the narrow range of reported quantities and frequencies of alcohol consumption during pregnancy, which means it was not possible to explore heavy or binge patterns of drinking in relation to diet. Recruiting heavy drinkers is a challenge commonly observed in epidemiological studies (60).

### *Conclusions and implications for practice*

The findings from this study have indicated that during pregnancy women have a heightened awareness of their diet and alcohol consumption and make concentrated efforts to change what they eat and drink during this period. Despite this some women do continue to drink, and those who drink low levels of alcohol during pregnancy may have better quality diets compared to women who report no alcohol consumption. The reasons for this are complex and influenced by social context and previous pregnancy experience, which should be considered by healthcare professionals providing advice during this period. Because of a woman's increased motivation to protect her baby, pregnancy is considered a teachable moment, which is defined as an event or circumstances that can result in behaviour change (55,56). Therefore, healthcare professionals should be given training and support to provide advice on tackling multiple health behaviours together to take advantage of this key time period. Midwives and other healthcare professionals require standardised mandatory training to update their knowledge on health risks associated with alcohol intake and to keep abreast of current recommendations for advice to provide women about health behaviours during pregnancy to avoid future inconsistencies. In 2015, a precautionary approach advising complete abstinence was advocated by the Royal College of Midwives (RCM, 2015) and is proposed for a revision of the UK guidelines (UK Chief Medical Officers 2016).

Evidence from health behaviour change interventions have indicated that when two or more health risk behaviours are approached in combination, individuals tend to have significantly better outcomes (57). However, the limitations of this study mean further investigation is required, with a larger and more diverse population, to explore further relationships between patterns of dietary intake and alcohol consumption before and during pregnancy.

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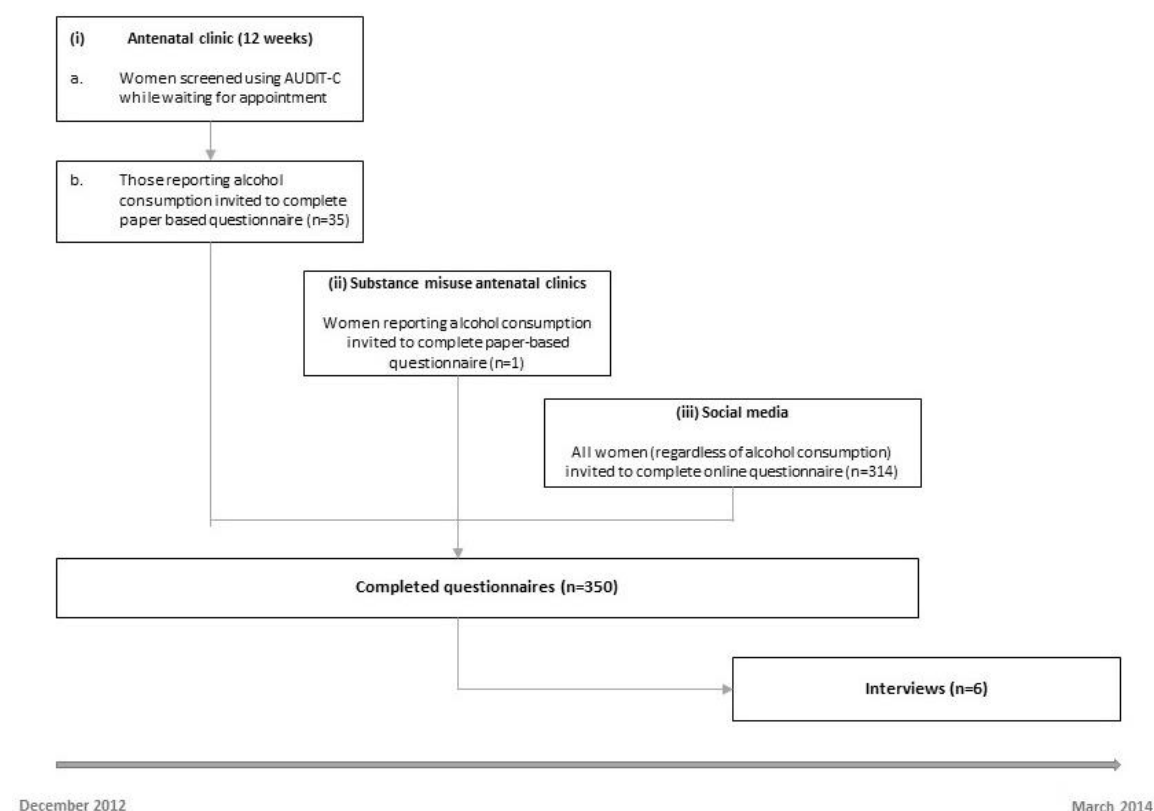


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## Figures and Tables



**Figure 1.** Participant recruitment for phase 1 and 2 of study and via three sources

**Table 1.** Socio-demographic characteristics of sample population for phase 1 (questionnaire) and 2 (interview) of study

	Questionnaire (n=350)		Interview (n=6)	
	n	%	n	%
<b>Age</b>				
≤25	39	11	1	17
26-30	87	25	2	33
31-35	140	40	2	33
>35	84	24	1	17
<b>Parity</b>				
Primiparous	186	53	3	50
Multiparous	164	47	3	50
<b>Marital status</b>				
Married	246	70	5	83
Not married	104	30	1	17
<b>Ethnicity</b>				
White	334	95	6	100
Non-white	16	5	0	0
<b>Education</b>				
<Bachelor's degree	111	32	1	17
≥Bachelor's degree	239	68	5	83
<b>Occupation</b>				
Managerial/Professional	180	51	3	50
Non-managerial/professional	109	31	2	33
Unemployed	61	17	1	17
<b>Smoking</b>				
Non-smoker	342	98	6	100
Smoker	8	2	0	0

**Table 2.** Frequency and percentages of alcohol consumption before and during pregnancy in sample population (n=350)

	n	%
<b>Frequency of alcohol consumption before pregnancy</b>		
<i>&lt;Monthly</i>	99	28
<i>2-4 times/month</i>	106	30
<i>2-3 times/week</i>	145	41
<b>Units of alcohol consumed per occasion before pregnancy</b>		
<i>≤1-2</i>	154	46
<i>3-4</i>	115	34
<i>5+</i>	65	20
<b>Frequency of binge drinking before pregnancy</b>		
<i>Never</i>	82	25
<i>&lt;Monthly</i>	144	43
<i>≥Monthly</i>	108	32
<b>Frequency of alcohol consumption during pregnancy</b>		
<i>Never</i>	236	67
<i>&lt;Monthly</i>	45	13
<i>2-4 times/month</i>	69	20
<b>Units of alcohol consumed during pregnancy*</b>		
<i>0</i>	236	67
<i>1-2</i>	114	33
<b>Frequency of binge drinking during pregnancy*</b>		
<i>Never</i>	348	99
<i>&lt;Monthly</i>	2	1
<i>≥Monthly</i>	0	0

\*low numbers in categories meant these variables were not explored in relation to diet

**Table 3.** Factor loadings from principal components analysis with varimax rotation for maternal dietary patterns\*

Dietary patterns	Prudent (8%)	Cafeteria (5%)
<b>Bread/pasta/rice</b>		
White bread	-0.14	0.10
Other bread	0.07	0.05
Rice	0.27	0.22
Pasta	0.17	0.16
<b>Breakfast foods</b>		
Breakfast cereals	0.19	-0.02
Cereal bars	0.02	0.00
<b>Animal produce</b>		
Sausages	-0.13	<b>0.67</b>
Burgers	-0.04	<b>0.37</b>
Bacon	-0.16	<b>0.43</b>
Steak	0.05	<b>0.57</b>
Chicken	-0.14	<b>0.40</b>
Pork/Lamb	0.07	0.28
Minced beef dishes	0.03	<b>0.71</b>
Fish	0.36	0.03
Prawns	0.24	0.02
Tinned fish	0.25	0.13
Eggs	<b>0.36</b>	0.02
<b>Vegetables</b>		
Potatoes	0.18	<b>0.30</b>
Sweet potatoes	0.20	0.11
Leeks	<b>0.44</b>	-0.02
Onions	<b>0.49</b>	0.07
Courgettes	<b>0.52</b>	-0.10
Beetroot	<b>0.42</b>	-0.04
Butternut Squash	<b>0.42</b>	-0.04
Cauliflower	<b>0.36</b>	<b>0.37</b>
Red/white cabbage	<b>0.44</b>	0.03
Frozen mixed vegetables	0.13	0.27
Coleslaw	0.26	0.24
Tinned tomatoes	<b>0.60</b>	0.11
<b>Salad vegetables</b>		
Lettuce	<b>0.56</b>	-0.04
Peppers	<b>0.63</b>	0.05
Cucumbers	<b>0.51</b>	-0.09
Tomatoes	<b>0.65</b>	-0.11

\*(Factor loadings in bold are  $\leq -0.3$  or  $\geq 0.3$ )

**Table 3. (cont.)** Factor loadings from principal components analysis with varimax rotation for maternal dietary patterns\*

Dietary patterns	Prudent (8%)	Cafeteria (5%)
<b>Green vegetables</b>		
Broccoli	<b>0.50</b>	0.13
Green cabbage	<b>0.47</b>	-0.05
Spinach	<b>0.59</b>	-0.12
Brussel sprouts	0.24	0.04
Green beans	<b>0.54</b>	0.16
Mange tout	<b>0.54</b>	0.04
Peas	<b>0.45</b>	<b>0.31</b>
<b>Fruit/fruit juice</b>		
Fresh fruit	<b>0.63</b>	-0.10
Tropical fruit	<b>0.47</b>	-0.07
Citrus fruit	<b>0.31</b>	0.02
Fruit juice	0.10	0.18
<b>Pulses/nuts</b>		
Baked beans	<b>0.31</b>	0.18
Chickpeas	<b>0.58</b>	-0.12
Nuts	<b>0.36</b>	-0.13
<b>Convenience foods</b>		
Pizza	-0.05	0.17
Chips	-0.19	<b>0.42</b>
Pies	-0.03	0.24
Crisps	-0.19	0.22
<b>Savoury snacks/sauces/spread</b>		
Quiche	0.11	0.11
Soup	0.14	-0.07
Tomato pasta sauce	0.34	0.20
Ketchup	0.02	0.19
Mayonnaise	0.12	0.14
Peanut butter	0.18	0.01
Marmite	0.16	-0.02
<b>Sweet foods</b>		
Puddings	0.02	<b>0.66</b>
Cakes	0.05	<b>0.64</b>
Biscuits	-0.05	0.22
Chocolate	-0.08	<b>0.31</b>
Pastries	0.01	<b>0.66</b>
<b>Drinks</b>		
Tea/coffee	0.07	0.04
Milk	0.13	0.21

\*(Factor loadings in bold are  $\leq -0.3$  or  $\geq 0.3$ )



**Table 4.** Estimates of dietary pattern scores by frequency of alcohol consumption prior to pregnancy (n=350)

Unadjusted					Adjusted*			
Model	β	95% CI		p-value	β	95% CI		p-value
<b>1: Prudent</b>								
Frequency of alcohol consumption:								
<Monthly								
2-4 times/month	0.21	-0.06	0.48	0.14	0.18	-0.1	0.46	0.201
2-3 times/week	0.46	0.2	0.71	<0.0001	0.38	0.11	0.65	0.006
<b>2: Cafeteria</b>								
Frequency of alcohol consumption:								
<Monthly								
2-4 times/month	-0.13	-0.41	0.14	0.34	-0.06	-0.33	0.21	0.668
2-3 times/week	-0.22	-0.48	0.04	0.09	-0.01	-0.27	0.26	0.963

CI = confidence intervals

\*Adjusted for maternal age, education, parity, ethnicity, occupation and smoking

**Table 5.** Estimates of dietary pattern scores by frequency of alcohol consumption during pregnancy (n=350)

Unadjusted					Adjusted*			
Model	β	95% CI		p-value	β	95% CI		p-value
<b>1: Prudent</b>								
Frequency of alcohol consumption:								
Never								
<monthly	0.3	-0.01	0.62	0.06	0.2	-0.12	0.52	0.219
2-4 times/month	0.44	0.17	0.7	<0.0001	0.36	0.09	0.63	0.009
<b>2: Cafeteria</b>								
Frequency of alcohol consumption:								
Never								
<monthly	0.06	-0.26	0.38	0.71	0.14	-0.18	0.45	0.396
2-4 times/month	-0.16	-0.43	0.11	0.24	0.01	-0.26	0.27	0.965

CI = confidence intervals

\*Adjusted for maternal age, education, parity, ethnicity, occupation and smoking

